

IAP20 Rec'd PCT/PTO 14 APR 2006  
Claims Amended according to Article 19

[1] (Amended) An internal combustion engine comprising:

    a cylinder block having one or more cylinders;

    a cylinder liner with a tubular shape, disposed inside said cylinder;

    a piston reciprocating inside said cylinder liner and having a top land portion formed of an outer periphery of the piston sandwiched between a piston head and an uppermost ring groove; and

        a liner installation ring forming a circular step portion inside the cylinder, and disposed in said cylinder block or said cylinder liner in such a manner that a bottom face of the liner installation ring faces to an uppermost portion of said cylinder liner, the circular step portion protruding to an inner periphery of said cylinder liner, wherein:

            said liner installation ring is disposed at a position in accordance with a top end position of said top land portion when said piston reaches a top dead center;

            a circular projection, in a tapered shape, inclining downwards to the inside of the cylinder from a crosspoint of the bottom face of said liner attachment ring and the inner periphery of said cylinder liner, is formed on the bottom face of said liner installation ring along an inner peripheral end thereof;

            an angle that a tapered surface of said projection forms with the inner periphery of said cylinder liner is in a range of 45 degrees to 60 degrees; and

            said liner installation ring is set to protrude from the inner periphery of said cylinder liner in an inward direction at a length of 0.05 mm or more to 0.5 mm or less.

[2] (Amended) An internal combustion engine comprising:

    a cylinder block having one or more cylinders;

    a cylinder liner with a tubular shape, disposed inside said cylinder;

a piston reciprocating inside said cylinder liner and having a top land portion formed of an outer periphery of the piston sandwiched between a piston head and an uppermost ring groove; and

a liner installation ring forming a circular step portion inside the cylinder, and disposed in said cylinder block or said cylinder liner in such a manner that a bottom face of the liner installation ring faces to an uppermost portion of said cylinder liner, the circular step portion protruding to an inner periphery of said cylinder liner, wherein:

said liner installation ring is disposed at a position in accordance with a top end position of said top land portion when said piston reaches a top dead center;

said liner installation ring is set to protrude from the inner periphery of said cylinder liner in an inward direction at a length of 0.05 mm or more to 0.5 mm or less;

a circular notch is formed on an internal diameter side of a contact face of said cylinder block or said cylinder liner with said liner installation ring; and

a groove portion is formed below said circular step portion, being sandwiched between the bottom face of said liner installation ring and said notch.

[3] (Amended) The internal combustion engine according to Claim 2, wherein:

said notch is formed in a tapered shape, inclining downwards from the contact face with said liner installation ring to the internal diameter side; and

an angle that the bottom face of said liner installation ring forms with a tapered surface of said notch is in a range of 45 degree to 60 degree.

[4] (Amended) The internal combustion engine according to any one of Claims 1 to 3, wherein

a ring-side circular groove is formed in the inner periphery of said liner installation ring in a peripheral direction of the ring.

[5] (Amended) An internal combustion engine comprising:

a cylinder block having one or more cylinders;  
a cylinder liner with a tubular shape, disposed inside said cylinder;  
a piston reciprocating inside said cylinder liner and having a top land portion formed of an outer periphery of the piston sandwiched between a piston head and an uppermost ring groove; and

a liner installation ring forming a circular step portion inside the cylinder, and disposed in said cylinder block or said cylinder liner in such a manner that a bottom face of the liner installation ring faces to an uppermost portion of said cylinder liner, the circular step portion protruding to an inner periphery of said cylinder liner, wherein:

said liner installation ring is disposed at a position in accordance with a top end position of said top land portion when said piston reaches a top dead center;

said liner installation ring is set to protrude from the inner periphery of said cylinder liner in an inward direction at a length of 0.05 mm or more to 0.5 mm or less; and

a ring-side circular groove is formed in the inner periphery of said liner installation ring in a peripheral direction of the ring.

[6] (Amended) The internal combustion engine according to any one of Claims 1 to 5, wherein

a piston-side circular groove is formed in the top land portion of said piston in a peripheral direction of the piston.

[7] (Amended) The internal combustion engine according to Claim 4 or 5, wherein:

a piston-side circular groove is formed in the top land portion of said piston in a peripheral direction of the piston in such a position to face to said ring-side circular groove when said piston reaches the top dead center.

[8] (Amended) The internal combustion engine according to any one of Claims 1

to 7, wherein:

a piston-side circular groove is also formed in a second land portion in the peripheral direction of the piston, the second land portion being positioned below the top land portion of said piston and the uppermost ring groove.

[9] (Amended) The internal combustion engine according to any one of Claims 4 to 10, wherein

a longitudinal section of at least one of said ring-side circular groove and said piston-side circular groove is V-shaped such that a top face thereof is horizontal or upwardly inclines to a bottom of the groove, and a bottom face thereof is tapered in such a manner that it goes away from the bottom of the groove as it goes downward.

[10] (Amended) The internal combustion engine according to any one of Claims 1 to 9, wherein:

an external diameter of said liner installation ring is set to be larger than an external diameter of an uppermost portion of said cylinder liner; and

a latch step portion is formed in the upper portion of said cylinder of said cylinder block and latches said liner installation ring to restrain its downward movement.

[11] (Amended) The internal combustion engine according to Claim 10, wherein:

the uppermost portion of said cylinder liner is positioned above the uppermost ring groove when said piston reaches the top dead center; and

the uppermost portion of said cylinder liner is disposed below said latch step portion with a distance.

[12] (Amended) The internal combustion engine according to any one of Claims 1 to 11, wherein

said liner installation ring has open parts in a peripheral direction thereof which face to each other with a predetermined distance, in order to fix said liner installation ring.

on said cylinder block or said cylinder liner by tension of the open parts separating from each other.

[13] A liner installation ring to be applied to an internal combustion engine that comprises a cylinder block having one or more cylinders with a latch step portion in its/their upper portion(s), and a tubular cylinder liner disposed in said cylinder, the liner installation ring being disposed in said latch step portion with its bottom face facing to an uppermost portion of said cylinder liner; while disposed, an inner peripheral end of the ring inwardly protruding from an inner periphery of said cylinder liner to said cylinder to form a circular step portion inside said cylinder, wherein:

a circular projection is provided in the bottom face along the inner peripheral end of the ring;

said projection is formed in a tapered shape such that it downwardly inclines to the inner periphery of the ring from a position of the inner periphery of the cylinder liner when the ring is disposed;

an angle that a tapered surface of said projection forms with the inner periphery of said cylinder liner is in a range of 45 degrees to 60 degrees; and

a length from a position of the inner periphery of the cylinder liner when said liner installation ring is disposed to the inner peripheral end of the disposed ring is set to be in a range of 0.05 mm to 0.5 mm.

[14] (Amended) A liner installation ring to be applied to an internal combustion engine that comprises a cylinder block having one or more cylinders with a latch step portion in its/their upper portion(s), and a tubular cylinder liner disposed in said cylinder, the liner installation ring being disposed in said latch step portion with its bottom face facing to an uppermost portion of said cylinder liner; while disposed, an inner peripheral end of the ring inwardly protruding from an inner periphery of said cylinder liner to said cylinder to form a circular step portion inside said cylinder, wherein:

cylinder to form a circular step portion inside said cylinder, wherein  
a length from a position of the inner periphery of the cylinder liner when said liner  
installation ring is disposed to the inner peripheral end of the disposed ring is set to be in a  
range of 0.05 mm to 0.5 mm; and  
the liner installation ring has a ring-side circular groove in the inner periphery in a  
peripheral direction of the ring.

[15] (Amended) The liner installation ring according to Claim 14, wherein  
a longitudinal section of said ring-side circular groove is V-shaped such that a top  
face thereof is horizontal or upwardly inclines to a bottom of the groove, and a bottom face  
thereof is tapered in such a manner that it goes away from the bottom of the groove as it  
goes downward.

[16] (Amended) The liner installation ring according to any one of Claim 13 to 15,  
wherein

the liner installation ring has open parts at a position in a peripheral direction of  
the ring; the open parts facing to each other with a predetermined distance.

[17] (Deleted)

[18] (Deleted)